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Environmental Restoration Project  
Standard Operating Procedure

for:

# Geomorphic Characterization

## Los Alamos

NATIONAL LABORATORY

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Los Alamos, New Mexico 87545

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## Revision Log

<b><i>Revision No.</i></b>	<b><i>Effective Date</i></b>	<b><i>Prepared By</i></b>	<b><i>Description of Changes</i></b>	<b><i>Affected Pages</i></b>
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R1	12/10/01	Steven Reneau	Revised to follow format of QP-04.02 R3 and to make procedure consistent with current geomorphic characterization activities in the ER Project	All

# Standard Operating Procedure Title

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# Geomorphic Characterization

## 1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the process for conducting geomorphic characterization of potentially-contaminated sediments for the Los Alamos National Laboratory (Laboratory) ER Project.

## 2.0 SCOPE

This SOP is a mandatory document and all ER Project participants shall implement this SOP when conducting geomorphic characterization of potentially-contaminated sediments for the Los Alamos National Laboratory (Laboratory) ER Project.

**Note:** Subcontractors performing work under the ER Project's quality program shall follow this SOP when conducting geomorphic characterization of potentially-contaminated sediments for the Los Alamos National Laboratory (Laboratory) ER Project or may use their own procedure(s) as long as the substitute meets the requirements prescribed by the ER Project Quality Management Plan, and is approved by the ER Project's Quality Program Project Leader (QPPL) before the commencement of the designated activities.

## 3.0 TRAINING

- 3.1 The **Focus Area Team Leader** (FATL) is responsible for ensuring that field team members who lead geomorphic characterization activities for the ER Project are familiar with the objectives of the specific field activity and possess sufficient geomorphic field experience to conduct this work.
- 3.2 For many geomorphic characterization activities, it is appropriate that the **Field Team Leader** (FTL) be a geomorphologist who both directs and participates in all aspects of the field activities. In addition, all field team members must document, using the training database located at <http://erinternal.lanl.gov/Training/Trainingmain.shtml>, that they read and understand this procedure in accordance with QP-2.2.

## 4.0 DEFINITIONS

**Note:** A glossary of definitions can be located on the ER Project internal homepage <http://erinternal.lanl.gov/WritingGuide.shtml>.

- 4.1 Site-Specific Health and Safety Plan (SSHASP)—A health and safety plan that is specific to a site or ER-related field activity that has been approved

by applicable ER Project health and safety representatives. This document contains information specific to the project including scope of work, relevant history, descriptions of hazards by activity associated with the project site(s), and techniques for exposure mitigation (e.g., personal protective equipment [PPE]) and hazard mitigation.

## **5.0 BACKGROUND AND PRECAUTIONS**

This SOP is not intended to provide complete training for conducting geomorphic characterization activities for the ER Project. It is instead intended to be used as a guide for adequately characterizing potentially contaminated sediment deposits by personnel with sufficient field experience in geomorphic characterization activities. Such geomorphic characterization is a primary component of work described in "*The Core Document for Canyons Investigations*" (LANL, 1997), and is also applicable to evaluating potential contamination for other parts of the ER Project. Examples of the results of geomorphic characterization activities can be found in Canyons reach reports (Reneau et al., 1998a; Reneau et al., 1998b; Reneau et al., 1998c; Katzman et al., 1999; Drakos et al., 2000), and these reports can serve as guides for the level of characterization that is required.

**Note:** This SOP is to be used in conjunction with an approved SSHASP. Also, consult the SSHASP for information on and use of all PPE.

## **6.0 RESPONSIBLE PERSONNEL**

The following personnel are responsible for activities identified in this procedure.

- 6.1 Author
- 6.2 Er Project Personnel
- 6.3 Field Team Leader
- 6.4 Focus Area Team Leader
- 6.5 Quality Program Project Leader

## **7.0 EQUIPMENT**

- 7.1 A checklist of suggested equipment and supplies needed to implement this procedure is provided in Attachment A.

## **8.0 PROCEDURE**

**Note:** Deviations from SOPs are documented in accordance with QP-5.7, Notebook Documentation for Environmental Restoration Technical Activities.

8.1 Prepare a geomorphic map of the area under investigation at a scale and level of detail appropriate to both the field setting and to the goals of the investigation.

**Note:** A map scale of 1:200 (1 cm = 2 m) has been found to be adequate to map geomorphic units in the narrowest canyon bottoms. Smaller map scales may be suitable for wider canyon bottoms. The smallest scale that has been useful in canyons is 1:1200 (1 cm = 12 m), which is the original scale of 1991 orthophotos prepared for the ER Project.

**Note:** In order to prepare a geomorphic map of sufficient accuracy, it is necessary to first establish a series of surveyed control points in the study area for use as local references. It must be realized that the standard FIMAD topographic maps with 2-foot contour intervals often do not adequately depict the location and orientation of stream channels in narrow, forested canyon bottoms at the Laboratory, and these topographic maps therefore cannot be consistently relied on to provide sufficient accuracy.

8.1.1 Define major geomorphic units in the investigation area, and delineate their boundaries in the field on a base map. The standard nomenclature that has been used in canyons investigations includes the initial designation "c" for post-1942 channel units (both active and abandoned channels), "f" for post-1942 floodplain units (areas impacted by flooding but not occupied by the main channel since 1942), and "Q" (Quaternary) for pre-1942 geomorphic units. "c" and "f" units are followed by numeric designators. For channel units, "c1" represents the active channel, "c2" represents the youngest abandoned channel unit, and so on. For floodplain units, "f1" indicates areas that have been inundated by post-1942 floods but that have not been occupied by the main channel during this period, and "f2" indicates areas that may have been impacted by post-1942 floods, but for which evidence is less certain. Subunits can also be broken out as appropriate (e.g., "c2a", "c2b"). Units can be differentiated based on either physical characteristics (e.g., height above channel, type and/or age of vegetation) or on contaminant characteristics (e.g., relative levels of radiation, as measured with field instruments). Map units should be delineated consistently within the map area, although the map units may vary between different parts of a canyon due to varying geomorphic conditions.

**Note:** One major goal of the map is allow areas to be calculated for each geomorphic unit. Combined with measurements of sediment thickness, these areas allow sediment volumes to be calculated. And combined with measurements of contaminant concentrations,

the volume estimates in turn allow estimation of contaminant inventories. The measured areas of the different units can also be incorporated into risk assessments and can be used in evaluating remedial alternatives.

- 8.1.2 Revise geomorphic map as needed, based on new field information or analytical results, or as the conceptual model of the site evolves.

**Note:** Geomorphic unit designations and boundaries of units may be subject to change as an investigation proceeds, as new information is obtained, and as the conceptual model of the site evolves. These changes to geomorphic unit designations are based on the judgement of the field mapper, and it is not necessary to formally document the reason for each change. However, each geomorphic map should indicate the date of the latest revision to avoid use of obsolete map versions. Each geomorphic map should also include the name of the mapper.

- 8.2 Describe the characteristics of each geomorphic unit in the map area.

- 8.2.1 Evaluate the nature and thickness of post-1942 sediment deposits in each geomorphic unit. Sediment deposits in each geomorphic unit should be examined at a series of locations within the area of investigation, either at stream bank exposures or in hand-dug holes. Because sediment characteristics vary laterally within each unit, a sufficient number of locations should be examined to incorporate this natural variation, with the number of locations determined in the field based on the professional judgement of the lead geomorphologist. A variety of criteria can be used to estimate the thickness of post-1942 sediment at each location, including the presence of buried soils or exotic materials, the depth of burial of trees, field radiological measurements, or contaminant levels as determined from analytical measurements of sediment samples. The thickness of fine-grained sediment should be given particular attention at each site because contaminant concentrations generally increase with decreasing particle size, and the highest concentrations and largest inventory are generally found in fine-grained sediments.

**Note:** Field estimates of median particle size in the <2 mm size fraction are initially used to differentiate fine-grained vs. coarse-grained sediment, with sediment with a median particle size of medium sand being used as an approximate boundary between these two sediment facies. Laboratory particle size analyses can be used to refine field estimates, as appropriate.

**Note:** Field notes on the stratigraphy at each location are used to determine average thicknesses for the purpose of calculating sediment volumes and to help select representative sample locations. Summary data on thicknesses within each unit should be captured in a final report, but it is not necessary to formally document the detailed stratigraphy at each site.

8.2.2 Obtain additional geomorphic information for map units as appropriate, based on the objectives of the investigation and the specific field setting. For example, information on the age of specific units can be obtained from an examination of sequential aerial photographs or by tree-ring dating.

## 9.0 REFERENCES

The following documents were cited within this procedure:

QP-2.2, Personnel Orientation and Training

QP-4.4, Record Transmittal to the Records Processing Facility

QP-5.7, Notebook Documentation for Environmental Restoration Technical Activities

Drakos, P., R. Ryti, S. Reneau, and K. Greene, 2000. "Evaluation of Possible Sediment Contamination in the White Rock Land Transfer Parcel: Reach CDB-4", Los Alamos National Laboratory Report LA-UR-00-5071, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1997. "Core Document for Canyons Investigations," Los Alamos National Laboratory Report LA-UR-96-2083, Los Alamos, New Mexico.

Katzman et al., R. Ryti, M., Tardiff, and B. Hardesty, 1999, "Evaluation of Sediment and Alluvial Groundwater in DP Canyon: Reaches DP-1, DP-2, DP-3, and DP-4", Los Alamos National Laboratory Report LA-UR-99-4238, Los Alamos New Mexico.

Reneau, S.L., R.T. Ryti, M. Tardiff, and J. Linn, 1998a, "Evaluation of Sediment Contamination in Lower Los Alamos Canyon: Reaches LA-4 and LA-5", Los Alamos National Laboratory Report LA-UR-98-3975, Los Alamos, New Mexico.

Reneau, S.L., R.T. Ryti, M. Tardiff, and J. Linn, 1998b, "Evaluation of Sediment Contamination in Pueblo Canyon: Reaches P-1, P-2, P-3, and P-4", Los Alamos National Laboratory Report LA-UR-98-3324, Los Alamos, New Mexico.

Reneau, S.L., R.T. Ryti, M. Tardiff, and J. Linn, 1998c, "Evaluation of Sediment Contamination in Upper Los Alamos Canyon: Reaches LA-1, LA-2, and LA-3",



## **10.0 RECORDS**

10.1 The FTL or other personnel as designated by the FATL or the FTL are responsible for submitting the following records (processed in accordance with QP-4.4, Record Transmittal to the Records Processing Facility) to the Records Processing Facility.

10.2 A report that includes documentation of the geomorphic characterization activities. This report may either be restricted to the geomorphic characterization activities or may be a more comprehensive investigation of the site in which the geomorphic characterization is one of several components. This report should include one or more geomorphic maps of the area under investigation, descriptions of each geomorphic unit on the map(s), and supplemental information on the geomorphology of the investigation area as considered appropriate by the FAPL or the FTL.

## **11.0 ATTACHMENTS**

Attachment A: Geomorphic Characterization Equipment and Supplies Checklist (1 page) located at  
<http://erinternal.lanl.gov/Quality/user/forms.asp>.

## Geomorphic Characterization Equipment and Supplies Checklist

- ☐ Notebook
- ☐ Base map(s)
- ☐ Tape measures
- ☐ Shovels
- ☐ Soil knife
- ☐ Nails
- ☐ Pin flags
- ☐ Flagging tape
- ☐ Compass
- ☐ Pruning shears
- ☐ Ruler
- ☐ Wooden Stakes
- ☐ Clip Board
- ☐ Rock Hammer
- ☐ Sharpie
- ☐ \_\_\_\_\_
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